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Noteworthy records of *Myotis* Kaup, 1829 species in northeastern Guatemala, including the first record of *M. volans* (H. Allen, 1866) (Chiroptera, Vespertilionidae) from the country

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Abstract. *Myotis* is the most diverse genus of bats in Central America, with 10 species currently reported for Guatemala. Here, we present the first record of *M. volans* (H. Allen, 1866), and third record of *M. auriculus* Baker & Stains, 1955 in Guatemala, both from the cloud forest of the highlands of Sierra de las Minas Biosphere Reserve. This new locality may serve as one of the southernmost habitats akin to North American ecosystems for these two species. Our record of *M. volans* increases the number of bats in Guatemala to 105. Our findings underscore the importance of further research to understand patterns of biodiversity in Guatemala and Central America.

Key words. Bats, cloud forest, distribution limit, range extension, Sierra de las Minas Biosphere Reserve, USAC Mammal Collection

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INTRODUCTION

Myotis Kaup, 1829 represents the most speciose genus of Chiroptera, with over 140 recognized species (Moratelli et al. 2019; MDD 2023; Simmons and Cirranello 2024). Its global distribution is notable, as it is the only genus of mammals found on every continent except Antarctica (Moratelli et al. 2019a; Liu et al. 2023; Ruedi et al. 2013). The Neotropical region is renowned for its exceptional bat diversity, exhibiting a high richness and several endemic species (Moratelli et al. 2001, 2013, 2016, 2017, 2019a, 2019b; Moratelli and Wilson 2011, 2014; Novaes et al. 2021, 2022a, 2022b; Carrión-Bonilla et al. 2024).

In Central America, *Myotis* is also the most diverse genus of bat, with Guatemala having the greatest species richness in the region (Kraker-Castañeda et al. 2016; Martínez-Fonseca et al. 2020; Turcios-Casco et al. 2020; Ramírez-Fernandez et al. 2023). Currently, 10 *Myotis* species are reported from Guatemala, including the endemic *M. cobanensis* Goodwin, 1955. Alongside the Guatemalan myotis, there are four other species unique to the region, whose southernmost distribution extends to Guatemala: *M. thysanodes* Miller, 1897; *M. auriculus*; *M. californicus* (Audubon & Bachman, 1842); and *M. fortidens* Miller & Allen, 1928 (Kraker-Castañeda et al. 2016).

Myotis auriculus, Southwest Myotis, is native to the southwestern United States, particularly New Mexico and Arizona, and Mexico north of Veracruz (Warner 1982; Arroyo-Cabrales et al. 2017). Currently two subspecies are recognized, *M. a. auriculus* in eastern Sierra Madre Oriental from Nuevo León to Tamaulipas and Veracruz (Mexico) and *M. a. apache* in northern Coahuila and southern Jalisco (Mexico) and the Arizona and New Mexico (USA) (Novaes 2019). In Guatemala, *M. a. auriculus* has been reported from San Francisco El Retiro, Huehuetenango, located in the northwest of the country, and Muxbal, in the department of Guate-mala in the central region of the country (GBIF 2024a; Portal de Biodiversidad de Guatemala 2024). *Myotis auriculus* commonly inhabits arid woodlands and desert scrub, but it is also found in diverse habitats such

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as mesquite forests, chaparral, oak woodlands, and coniferous forests (Arroyo-Cabrales et al. 2017; Reid 2009; Warner 1982). They are associated with areas with rocky cliffs near water sources, often roosting in caves at elevations of about 300–2,200 m a.s.l. (Reid 2009; Warner 1982).

Myotis volans, Long-legged Myotis, is native to western North America. Its range extends from southeastern Alaska through Canada and the United States to central Mexico (Warner and Czaplewski 1984; Solari 2019). This distribution encompasses a vast range of geography and ecosystems, from temperate forests to arid landscapes (GBIF 2024b). Four subspecies are recognized, with *M. v. volans* found in northwestern Mexico, including Baja California, *M. v. amotus* in south-central Mexico, *M. v. interior* in the western and central United States, and *M. v. longicrus* the northwestern United States and western Canada to southern Alaska (Burgin 2019). It inhabits elevations ranging from 60 to 3,770 m a.s.l., although it is predominantly found between 2,000 and 3,000 m a.s.l. Mainland populations typically inhabit montane habitats and are rarely found in arid lowland areas (Warner and Czaplewski 1984; Solari 2019).

Here, we provide the first record of *M. volans* in Central America, from the Sierra de las Minas Biosphere Reserve (SMBR) in northeastern Guatemala. Additionally, we document the third record of *M. auriculus* from Guatemala.

METHODS

Sierra de las Minas Biosphere Reserve (SMBR) is a 130 km mountain range in northeastern Guatemala between the Motagua and Polochic valleys and geological faults. This region is characterized by significant topographic variability, with elevations ranging from sea level to 3,015 m a.s.l. (Figure 1; Matson et al. 2016). The diverse geographical features of the SMBR contain a wide range of ecosystems, each with its own distinct climatic conditions and plant communities (Figure 2A, B; IARNA-URL 2018). Encompassing an approximate area of 2400 km^2, the SMBR is situated between the departments of El Progreso, Zacapa, Izabal, Alta Verapaz, and Baja Verapaz and includes the largest extent of cloud forest in Central America (Matson et al. 2016). The capture site was located on the southern slope of the mountain range, within the cloud forest of San Agustín Acasuaguastlán in El Progreso Department.

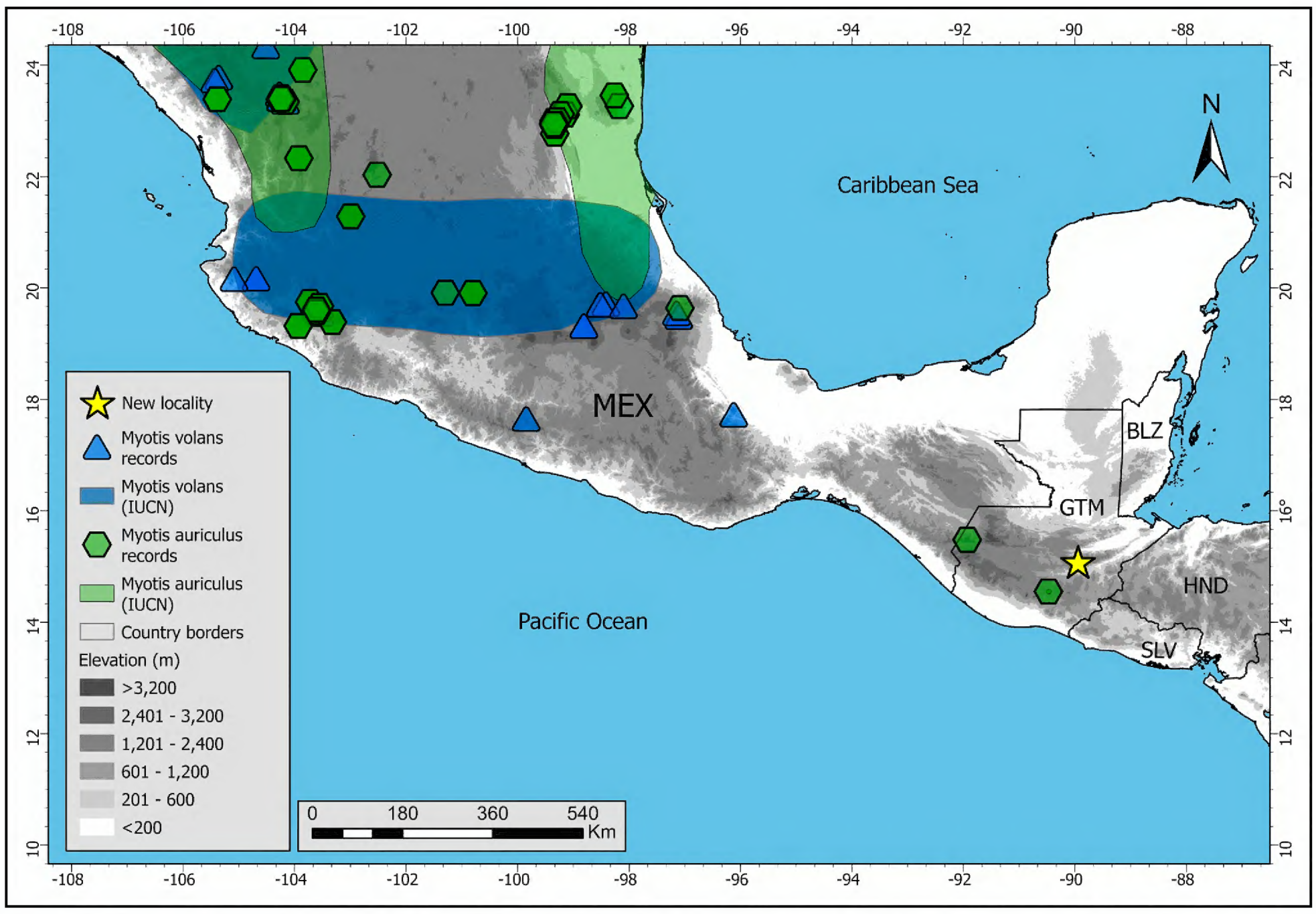

Figure 1. Distribution ranges and confirmed localities of *Myotis auriculus* Baker & Stains, 1955 and *M. volans* (H. Allen, 1866) in southern Mexico and Central America. Yellow star indicates new locality for both species in Sierra de las Minas Biosphere Reserve in Guatemala.

Figure 2. Representative habitat in new locality, Sierra de las Minas Biosphere cloud forest. **A.** Forest path. **B.** View of the tree canopy.

Bats were captured using a combination of mist nets of varying lengths (6 and 12 m), positioned at ground level or using triple-high nets placed across natural flyways such as forest paths and water sources, following Kunz and Parsons (2009). Nets were deployed shortly before sunset (approximately at 5:30pm) and left open for about 5 h. We recorded morphometric measurements from each of the individuals including head and body length (HB), forearm length (FA), ear length (E), tail length (T), hindfoot (HF), tibia length (Tibia), and weight (Wt). Field identifications were made using the keys and guides by Medellín et al. (2008), Reid (2009), and York et al. (2019). Nomenclature and taxonomic order follow the guidelines provided by Simmons and Cirranello (2024). Individuals were handled in accordance with the protocols established by the American Society of Mammalogists (Sikes and the Animal Care and Use Committee of the American Society of Mammalogists 2016) and under permits granted by the Consejo Nacional de Áreas Protegidas (CONAP) as co-administrators of the protected area (governmental decree no. 93-93). The skin, skull, and tissues, as well as photographic records, were deposited in the Universidad de San Carlos de Guatemala Mammal Collection (USAC).

Existing locality records for the two species were reviewed using museum specimen localities available through the Global Biodiversity Information Facility (https://www.gbif.org; GBIF). Data from GBIF were acquired by defining the search based on: "Species = XXX"; "Basis of record = Preserved specimen; Material sample; Occurrence"; "Location = Including coordinates" (GBIF 2024a, 2024b). Complementary information was obtained through the Portal de Biodiversidad de Guatemala (https://biodiversidad.gt/). Additionally, we consulted the latest checklist and publications of bats in Guatemala to further understand the species' distributions within the study area and the country (Kraker-Castañeda et al. 2016; Trujillo et al. 2020, 2021).

RESULTS

***Myotis auriculus* Baker & Stains, 1955**
Figure 3A

New records. GUATEMALA – El Progreso • San Agustín Acasaguastlán, Reserva de la Biosfera Sierra de las Minas; 15.08361, −089.94306; 2,573 m a.s.l.; 8.II.2024; CM, LAT, LEGL, JGMF, MH obs.; mist net set in a water body in preserved clouded forest fragment; FA 40 mm; E 17 mm; Wt 7 g; 1 ♂, adult, released, photographic record, USACF000017.

Identification. *Myotis auriculus* is a medium-sized to large bat compared to Mesoamerican *Myotis* and belongs to the long-eared myotis species group (Genoways and Knox 1969; Reduker et al. 1983; Gannon and Rácz 2006). Our specimen of *M. auriculus* (Figure 3A) is clearly distinguishable from its congeners in the region by its relatively large size and long ears; all measurements fall within the range described for *M. auriculus* (Reid 2009; Warner 1982). Our specimen had the typical long and woolly matte-brown dorsal fur, with bicolored hair having a dark brown base and duller brown or yellow-brown tips (Novaes 2019). The long brown ears turn black from the middle to the tip, and the narrow, pointed tragus is very evident and characteristic of the species (Novaes 2019). The calcar lacked a keel. This species can be further distinguished from other superficially similar species, like *M. thysanodes*, due to the absence of a fringe of hairs on the tail membrane and relatively shorter tail (Warner 1982; Medellín et al. 2008; Reid 2009).

***Myotis volans* (H. Allen, 1866)**
Figure 3B-D

New records. GUATEMALA – El Progreso • San Agustín Acasaguastlán, Reserva de la Biosfera Sierra de las Minas; 15.08361, −089.94306; 2,573 m a.s.l.; 8.II.2024; CM, LAT, LEGL, JGMF, MH leg.; mist net set over a water body in preserved clouded forest fragment; HB 47 mm; FA 40 mm; E 11 mm; T 40 mm; HF 8 mm; Tibia 21mm; Wt 5 g; 1 ♂, adult, skin, skull and tissues, USAC 6415.

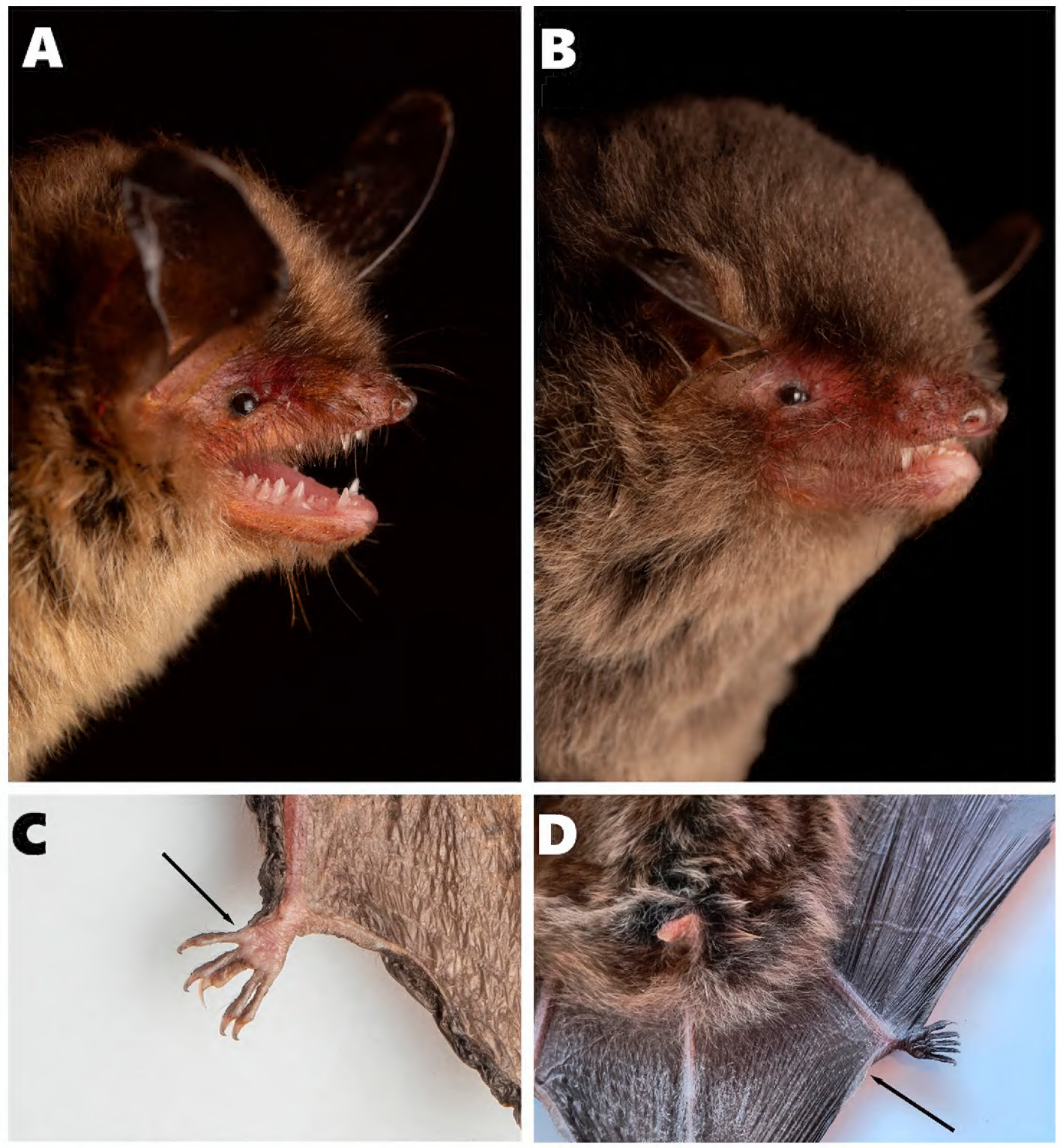

Figure 3. *Myotis auriculus* Baker & Stains, 1955 and *M. volans* (H. Allen, 1866) from Sierra de las Minas Biosphere Reserve, Guatemala. **A.** Lateral view of *Myotis auriculus* Baker & Stains, 1955, USACF000017. **B.** Lateral view of *Myotis volans* (H. Allen, 1866), USACF000018_1. **C.** Wing membranes attach to the hindfoot at the middle of the metatarsus in *M. volans* (H. Allen, 1866), USACF000018_2. **D.** Keeled calcar in *M. volans* (H. Allen, 1866), USACF000018_3.

Identification. *Myotis volans* is a medium-sized myotis species with a relatively long tail and short, rounded ears which, when laid forward, barely reach the snout (Ammerman et al. 2012). The examined specimen matches this general description with its short, furry snout (Figure 3B; Burgin 2019). Our specimens had dark brown dorsal fur and light brown ventral fur, as noted by Burgin (2019). The wing membranes in our specimen were attached to the hindfoot at the middle of the metatarsus, which is diagnostic for this species (Figure 3C; Warner and Czaplewski 1984). It also has a prominently keeled calcar (Figure 3D) and sparse fur on the wing membrane, which extends from the body to the line of the knee and barely reaches the elbow, which is also a diagnostic characteristic of this species (Warner and Czaplewski 1984; Ammerman et al., 2012; Schmidly and Bradley 2016). All measurements of our specimen are within the range described for the species (Warner and Czaplewski 1984; Ammerman et al. 2012; Schmidly and Bradley 2016; Burgin 2019). When compared to its congeners, our specimen has a relatively long tibia (21 mm). The only other species within the region with a keeled calcar is *M. californicus,* from which *M. volans* can be distinguished by its larger size (FA ≥ 38 mm; Reid 2009; Burgin 2019). *Myotis californicus* is usually pale yellow in the southern limits of its distribution (Burgin 2019).

DISCUSSION

Our records extend the geographical range of *Myotis auriculus* and *M. volans* east and southward. For *M. auriculus*, this represents the third documented report of the species in Guatemala and Central America. Previously, the southernmost record for the species was at Muxbal, Guatemala, approximately 79 km into the central region of the country. Notably, two of these records represent the highest elevational records for the species: 2,573 m a.s.l. in the SMBR (this study) and 2,975 m a.s.l. in San Francisco El Retiro, Huehuetenango (USACM5757; available at biodiversidad.gt). The highest elevation where *M. auriculus* was previously reported was at 2,226 m a.s.l. in Arizona (Warner 1982; Arroyo-Cabrales et al 2017). Our record of *M. volans* in Guatemala also represents the first record for Central America, extending the range of the species by at least 910 km southeastward of its previously known range at Cofre de Perote in Veracruz, Mexico (GBIF 2024b).

The addition of *M. volans* to the bat fauna of Guatemala increases the number of reported species from the country to 105. In the last few years, the molossid species *Nyctinomops macrotis* (Gray, 1840), *N. aurispinosus* (Peale, 1848), *N. femorosaccus* (Merriam, 1889), and *Eumops underwoodi* Goodwin, 1940 were added to the bat fauna of Guatemala (Kraker-Castañeda et al. 2016; Trujillo et al. 2020; Trujillo et al. 2021). This supports the notion that Guatemala's bat fauna is significantly more diverse than previously thought. Indeed, it is safe to assume that there are several species yet to be found in the country (McCarthy and Pérez 2006). This pattern also holds true in other Central American countries (Martínez-Fonseca et al. 2024).

Our records reaffirm *Myotis* as the richest bat genera of the country (see also Kraker-Castañeda et al. 2016). It is noteworthy that five of these species reach their southernmost distribution limit in Guatemala: *M. californicus*, *M. volans*, *M. thysanodes*, *M. fortidens*, and *M. auriculus*. Furthermore, *M. auriculus*, *M. thysanodes*, and *M. volans* reach their limit in the SMBR (this study; McCarthy and Pérez 2006). The documentation of *M. auriculus* and *M. volans* in the SMBR is a significant addition to the understanding of bat diversity and its distribution in Guatemala and Central America. These findings highlight the importance of this region as a key habitat for bat species and underscore the critical need for further research to fully comprehend the ecological importance of the SMBR. The highlands of Sierra de las Minas may serve as one of the southernmost remaining habitats with conditions like those found in North American ecosystems for these species. Our findings emphasize the urgent need to strengthen conservation efforts to preserve these unique habitats and the biodiversity they support.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: LAT, JGMF. Data curation: LAT, JGMF. Investigation: LAT, JGMF, CM, MH, LEGL. Writing – original draft: LAT. Writing – review and editing: LAT, JGMF, CM, MH, LEGL. Visualization: JGMF, LAT.

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Data availability

All data that support the findings of this study are available in the main text.

REFERENCES

Ammerman LK, Hice CL, Schmidly DJ (2012) Bats of Texas. University Press, Texas, USA, 309 pp.

Arroyo-Cabrales J, Miller B, Reid F, Cuarón AD, de Grammont PC (2017) *Myotis auriculus*. The IUCN Red List of Threatened Species 2017: e.T14145A22060698. https://doi.org/10.2305/lucn.uk.2017-2.rlts.T14145a22060698.en. Accessed on: 2024-04-26.

Burgin CJ (2019) *Myotis volans*. In: Wilson DE, Mittermeier RA (Eds.) Handbook of the mammals of the world, vol. 9, Bats. Lynx Editions, Barcelona, Spain, 930.

Carrión-Bonilla, CA, Ron S, Cook JA (2024) Species richness in Myotis (Chiroptera: Vespertilionidae): species delimitation and expanded geographic sampling reveal high Neotropical diversity. Journal of Mammalogy 105: 241–258. https://doi.org/10.1093/jmammal/gyad124

Gannon WL, Rácz GR (2006) Character displacement and ecomorphological analysis of two long-eared myotis (*M. auriculus* and *M. evotis*). Journal of Mammalogy 87: 171–179. https://doi.org/10.1644/05-MAMM-A-140R1.1

GBIF (2024a) *Myotis auriculus*. Global Biodiversity Information Facility Occurrence Download. https://doi.org/10.15468/dl.kn7kvk Accessed on: 2024-04-26.

GBIF (2024b) *Myotis volan*s. Global Biodiversity Information Facility Occurrence Download. https://doi.org/10.15468/dl.a4a9cr Accessed on: 2024-04-26.

Genoways H, Jones Jr JK (1969) Taxonomic status of certain long-eared bats (genus *Myotis*) from the southwestern United States and Mexico. The Southwestern Naturalist 1–13.

Genoways H, Jones Jr JK (1969) Taxonomic status of certain long-eared bats (genus *Myotis*) from the southwestern United States and Mexico. The Southwestern Naturalist 14: 1–13. https://doi.org/10.2307/3669245

IARNA-URL (Instituto de Investigación y Proyección sobre Ambiente Natural y Sociedad de la Universidad Rafael Landívar) (2018) Ecosistemas de Guatemala basado en el sistema de clasificación de zonas de vida. Technical Report. IARNA-URL, Guatemala, Guatemala, 122 pp.

Kraker-Castañeda C, Pérez S, Cajas-Castillo J, Echeverria-Tello J (2016) Lista actualizada de los murciélagos (Mammalia, Chiroptera) de Guatemala. Revista Mexicana de Biodiversidad 87: 409–416. http://doi.org/10.1016/j.rmb.2015.10.005

Kunz TH, Parsons S (2009) Ecological and behavioral methods for the study of bats. Second edition. Johns Hopkins University Press, Baltimore, USA, 920 pp.

Liu T, Jia J, Liu L, Wang J, Chen W, Miao G, Niu Y, Guo W, Zhang K, Sun K, Yu W, Zhou J, Feng J (2023) New insights into the taxonomy of *Myotis* bats in China based on morphology and multilocus phylogeny. Diversity 15: 1–12. https://doi.org/10.3390/d15070805

Martínez-Fonseca JG, Medina-Fitoria A, Westeen EP, Chambers CL (2020) Revised checklist of the bats (Mammalia: Chiroptera) of Nicaragua. Occasional Papers of the Museum of Texas Tech University 369: 1–36.

Martínez-Fonseca JG, Trujillo LA, Westeen EP, Reid FA, Hood C, Fernández-Mena MA, Gutiérrez-López LE, Molina-Loza JC, Chambers CL (2024) New departmental records of mammals (Mammalia, Theria) from Nicaragua. Check List 20: 706–720. https://doi.org/10.15560/20.3.706

Matson JO, Eckerlin RP, Pérez-Consuegra SG, Ordóñez-Garza N (2016) Small mammals from three mountain ranges in Nuclear Central America. Annals of Carnegie Museum 83: 269–285.

McCarthy T, Pérez S (2006) Land and freshwater mammals of Guatemala: faunal documentation and diversity. In: Cano E (Ed.) Biodiversidad de Guatemala. Universidad del Valle de Guatemala, Guatemala City, Guatemala, 625–674.

MDD (Mammal Diversity Database) (2023) Mammal Diversity Database (version 1.12.1) [data set]. Zenodo. https://doi.org/10.5281/zenodo.10595931 Accessed on: 2024-04-26.

Medellín R, Arita H, Sánchez O (2008) Identificación de los Murciélagos de México: Clave de Campo. Instituto de Ecología, UNAM. Ciudad de México, México, 78 pp.

Moratelli R, Wilson DE (2011) A new species of *Myotis* Kaup, 1829 (Chiroptera, Vespertilionidae) from Ecuador. Mammalian Biology 76: 608–614. https://doi.org/10.1016/j.mambio.2010.10.003

Moratelli R, Wilson DE (2014) A new species of *Myotis* (Chiroptera, Vespertilionidae) from Bolivia. Journal of Mammalogy 95: 17–25. https://doi.org/10.1644/14-MAMM-149

Moratelli R, Peracchi AL, Dias D, Oliveira JA (2011) Geographic variation in South American populations of *Myotis nigricans* (Schinz, 1821) (Chiroptera, Vespertilionidae), with the description of two new species. Mammalian Biology 76: 592–607. https://doi.org/10.1016/j.mambio.2011.01.003

Moratelli R, Gardner AL, Oliveira JA, Wilson DE (2013) Review of *Myotis* (Chiroptera, Vespertilionidae) from northern South America, including description of a new species. American Museum Novitates 3780: 1–36. https://doi.org/10.1206/3780.2

Moratelli R, Novaes RLM, Carrión-Bonilla C, Wilson DE (2019a) A new species of *Myotis* (Chiroptera, Vespertilionidae) from Peru. Special Publications of the Museum of Texas Tech University 71: 239–256.

Moratelli R, Wilson DE, Gardner AL, Fisher RD, Gutiérrez EE (2016) A new species of *Myotis* from Suriname (Chiroptera, Vespertilionidae). Occasional Papers of the Museum of Texas Tech University 65: 49–63.

Moratelli R, Wilson DE, Novaes RLM, Helgen KM, Gutiérrez EE (2017) Caribbean *Myotis* (Chiroptera, Vespertilionidae), with description of a new species from Trinidad and Tobago. Journal of Mammalogy 98: 994–1008. https://doi.org/10.1093/jmammal/gyx062

Moratelli R, Burgin C, Cláudio VC, Novaes RLM, López-Baucells A, Haslauer R (2019b) Family Vespertilionidae (vesper bats). In: Wilson DE, Mittermeier AR (Eds.) Handbook of the mammals of the world, vol. 9. Bats. Lynx Editions, Barcelona, 716–981.

Novaes RLM (2019) *Myotis auriculus.* In: Wilson DE, Mittermeier RA (Eds.) Handbook of the mammals of the world, vol. 9, Bats. Lynx Editions, Barcelona, Spain, 925.

Novaes RLM, Wilson DE, Moratelli R (2021) A new species of *Myotis* (Chiroptera, Vespertilionidae) from Uruguay. Vertebrate Zoology 71: 711–722. https://doi.org/10.3897/vz.71.e73146

Novaes RLM, Cláudio VC, Díaz MM, Wilson DE, Weksler M, Moratelli R (2022a) Argentinean *Myotis* (Chiroptera, Vespertilionidae), including the description of a new species from the Yungas. Vertebrate Zoology 72: 1187–1216. https://doi.org/10.3897/vz.72.e90958

Novaes RLM, Cláudio VC, Carrión-Bonilla C, Abreu EF, Wilson DE, Maldonado JE, Weksler M (2022b) Variation in the *Myotis keaysi* complex (Chiroptera, Vespertilionidae), with description of a new species from Ecuador. Journal of Mammalogy 103: 540–559. https://doi.org/10.1093/jmammal/gyab139

Portal de Biodiversidad de Guatemala (2024) *Myotis auriculus*. ID de Ocurrencia: 040aca50-7ae1-4e76-9986-658cb-fc6983e. https://biodiversidad.gt/portal/collections/individual/index.php?occid=6803&clid=. Accessed on: 2024-04-26.

Ramírez-Fernández J, Sánchez R, May-Collado L, González-Maya J, Rodríguez-Herrera B (2023) Revised checklist and conservation status of the mammals of Costa Rica. Therya 14: 1–12. https://doi.org/12933/therya-23-2142

Reduker DW, Yates TL, Greenbaum IF (1983) Evolutionary affinities among southwestern long-eared myotis (Chiroptera: Vespertilionidae). Journal of Mammalogy 64: 666–677. https://doi.org/10.2307/1380523

Reid FA (2009) A field guide to the mammals of Southeast Mexico and Central America. 2nd ed. Oxford University Press, New York, USA, 346 pp.

Ruedi M, Stadelmann B, Gager Y, Douzery EJP, Francis CM, Lin LK, Guillén-Servent A, Cibois A (2013) Molecular phylogenetic reconstructions identify East Asia as the cradle for the evolution of the cosmopolitan genus *Myotis* (Mammalia, Chiroptera). Molecular Phylogenetics and Evolution 69: 437–449. https://doi.org/10.1016/j.ympev.2013.08.011

Sikes RS, the Animal Care and Use Committee of the American Society of Mammalogist (2016) Guidelines of the American Society of Mammalogists for the use of wild mammals in research and education. Journal of Mammalogy 97: 663–688. https://doi.org/10.1093/jmammal/gyw078

Simmons, NB, Cirranello AL (2024) Bat species of the world: a taxonomic and geographic database. Version 1.5. https://batnames.org/home.html. Accessed on: 2024-05-11.

Schmidly DJ, RD Bradley (2016) The mammals of Texas. Austin: University of Texas Press, Texas, USA, 720 pp. https://doi.org/10.7560/308868

Solari S (2019) *Myotis volans*. The IUCN Red List of Threatened Species 2019: e.T14210A22069325. Accessed on: 2024-04-26. https://doi.org/10.2305/iucn.uk.2019

Trujillo LA, Barahona-Fong R, Pérez SG (2020) Filling gaps in the distribution of the four free-tailed bat species of the genus *Nyctinomops* Miller, 1902 (Mammalia, Chiroptera, Molossidae), with three new records for Guatemala. Check List 16: 1747–1754. https://doi.org/10.15560/16.6.1747

Trujillo LA, Barahona-Fong R, Kraker-Castañeda C, Medina-Fitoria A, Hernández J, Pérez SG (2021) Noteworthy records of bats of the genus *Eumops* Miller, 1906 from Guatemala: first confirmed record of Underwood's Bonneted Bat, *Eumops underwoodi* Goodwin, 1940 (Mammalia, Chiroptera, Molossidae), in the country. Check List 17: 1147–1154. https://doi.org/10.15560/17.4.1147

Turcios-Casco MA, Ávila-Palma HD, LaVal RK, Stevens RD, Ordoñez-Trejo EJ, Soler-Orellana JA, Ordoñez-Mazier DI (2020) A systematic revision of the bats (Chiroptera) of Honduras: an updated checklist with corroboration of historical specimens and new records. Zoosystematics and Evolution 96: 411–429. https://doi.org/10.3897/zse.96.51059

Warner RM (1982) *Myotis auriculus*. Mammalian Species 191: 1–3.

Warner RM, Czaplewski NJ (1984) *Myotis volans*. Mammalian Species 224: 1–4.

York HA, Rodríguez-Herrera B, LaVal RK, Timm RM, Lindsay KE (2019) Field key to the bats of Costa Rica and Nicaragua. Journal of Mammalogy 100: 1726–1749. https://doi.org/10.1093/jmammal/gyz150